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Steel: Chemical Composition and Hardenability

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1. SCOPE

This document, as referenced in the applicable product specifications in procurement documents, contains:

- a. A catalog of the standard carbon steels, alloy steels (including H-steels), and stainless and heat-resisting steels that are designated by chemical composition, or (for H-steels) by chemical composition and hardenability limits by reference to standard industry documents.
- b. Rules for designating the chemical content of carbon steels, alloy steels, and stainless and heat-resisting steels that are not classified as standard.

2. CLASSIFICATION AND DESIGNATION OF STEELS BY CHEMICAL COMPOSITION

2.1 Classification

Chemical composition indicates only one aspect of a steel product and is not to be considered as a complete guide to quality and performance. Chemical composition, however, is the most common basis for the classification and designation of steels. The precise chemical content, together with the desired form (bar, sheet, strip, plate, etc.) and the size (primarily cross-sectional area or diameter, will determine whether a given product can be obtained simply by ordering a standard steel, or whether all the requirements must be specified in detail.

2.2 Standard Steels

Standard steels have specified compositions and are limited to particular forms and sizes. These steels have individual numerical designations assigned by industry to facilitate ordering, as shown in Table 1. The numbers are for identification and are not indicative of quality. The steel numbers used in this document are generally Unified Numbering System (UNS) numbers; Society of Automotive Engineers (SAE) numbers are included for further information.

In general, standard steels are used more often and are more readily available than other compositions.

2.3 Former Standard Steels

These steels were formerly listed as “standard steels” in previous editions of this document, the AISI manuals, and SAE Surface Vehicle Standards, but, because of decreased usage, they have been placed in separate tables in the referenced documents and in SAE Surface Vehicle Standard J1249.

2.4 Nonstandard Steels

Nonstandard steels are steels that do not fall into the category of standard steels because of differences in their composition. These unlisted steels must be ordered by specifying the chemical content in accordance with established ranges and limits.

2.5 H-Steels

A number of alloy steels, identified by the prefix or suffix letter “H” to the steel number, may be designated by a combination of hardenability and composition. The hardenability data compiled for each of these steels, have been derived from extensive standard (Jominy) end-quench hardenability testing, and have been incorporated into composite graphs. Each graph has two curves, plotted from the maximum and minimum hardness values reported for 1/16-inch distances from the quenched end of a standard 1-inch diameter specimen. The band created by these two curves defines the hardness limits for that composition. Hardenability bands and directions for their use in specifying H-steels are explained in 7.2.